



Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of)	
)	
Preserving the Open Internet)	GN Docket No. 09-191
)	
Broadband Industry Practices)	WC Docket No. 07-52

**Rebuttal to Free Press NPRM, comments by George Ou,
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Introduction

Free Press is asking the FCC to consider a number of changes¹ to the NPRM Net Neutrality regulations, which it claims will “promote investment.” To achieve this goal, Free Press wants the FCC to implement the following regulations:

- Prohibit broadband providers from offering premium services
- Eliminate existing managed services for broadband providers
- Mandate dumb and problematic networks
- Make drastic changes to existing wireless business models

Upon examining the Free Press proposal in detail, we find that it would produce the opposite effect and devastate the U.S. economy. By precluding broadband providers from innovative new business models and economic opportunities, and undermining their existing business models and revenue streams, the Free Press proposal would result in substantial net losses for the economy.

Prohibit broadband providers from offering premium services

Free Press insists that “pay for priority” services are bad in the following argument:

“Pay-for-Priority” — Under this scheme, third-party content and applications providers would compensate ISPs for prioritizing their traffic over all other traffic flowing across the ISP’s network. But this model is faced with an immovable barrier: the routing of Internet packets is a zero-sum-game; during times of congestion, prioritizing one packet deprioritizes all others. This practical reality firmly bounds the possibilities of the pay-for-priority business model. In practice, this means that in order for this model to work, congestion will have to be widespread. This in turn means that ISPs will likely form exclusive paid-priority relationships, resulting in the Balkanization of the Internet.”

Free Press seems to be stuck on the concept of the zero-sum game. Network prioritization is not a zero-sum game because ISPs generally connect premium peering customers to new, dedicated infrastructure without piling them onto the existing, general-purpose infrastructure. That means premium services do not decrease the available capacity to standard customers but do the opposite because premium customers are no longer using the standard-tier infrastructure.

Can broadband providers really engage in artificial scarcity?

The “last mile” (a.k.a., the access network, often known as the broadband network) is often shared, but ISPs spend billions of dollars a year ensuring that capacity grows with traffic load so that customer experience isn’t degraded because ISPs can’t afford to lose customers and reputation. As premium services put more load on the broadband network, it not only creates a need to upgrade the network but also provides the necessary revenue to fund the upgrades. Yet Free Press also argues that:

“Without Network Neutrality, ISPs will have a strong incentive to reduce investment and make congestion commonplace in order to extract revenues from content providers willing to pay to avoid traffic delays.”

The fallacy with this argument is that it assumes ISPs can permit their network performances to degrade without alienating existing customers and driving them to a competitor. The reality is that bad service results mean losing more customers and struggling to attract new ones. This outweighs the cost savings of skimping on infrastructure, and it endangers the long-term reputation of the ISP. All ISPs monitor their network load levels in every part of their network, and they respond to increasing traffic by spending tens of billions of dollars every year upgrading their networks. If ISPs faced no competitive pressure, they would surely refuse to spend billions of dollars on annual upgrades. In fact, it would be their duty to shareholders to avoid spending billions if they could do so without losing customers, but they clearly do not have the market power to do this.

The reality is that ISPs must deal with increased congestion, and according to company reports and data from the CTIA and NCTA, ISPs spent \$60.7 billion in 2007 upgrading wired and wireless network infrastructure. By comparison, all the dot-coms that are supposedly more important to the Internet economy than the ISPs (including Google, eBay, Yahoo and many others that signed a letter demanding Net Neutrality regulation in 2009) spent a mere \$9.2 billion in 2007 combined! That's less than the \$17.5 billion spent in 2007 by just Verizon building out network infrastructure.

Furthermore, it is a fallacy to suggest that premium services would harm content and application providers because premium peering services are cheaper than traditional means². Banning these premium services harms the small to medium-sized dot-coms by preventing them from purchasing cheaper and faster bandwidth. We must not preclude innovative new business models on the Internet, and we must preserve the open and competitive bandwidth market³. Broadband companies are some of the largest and most crucial segments of the Internet economy, and new business models and revenue streams will fuel the Internet's growth.

The myth that dot-coms drive the Internet economy

Free Press is essentially arguing that it is more important to promote dot-com growth than ISP growth by means of new regulation. But if we look at the numbers, the most dominant dot-com, Google, needed \$29.20 of revenue (2009 data) for every dollar invested on capital expenditure. But the three largest U.S.-based ISPs -- AT&T, Verizon and Comcast -- on average only needed \$6.92 of revenue for every dollar they invested in capex, which means these ISPs invest 4.2 times more money for every dollar of revenue than Google.

These capex investments indirectly translate to many more American jobs, which means the ISPs are a much larger economic force than the dot-coms. If we look at employment by Google versus the three largest ISPs, ISPs provide about 2.9 times more jobs for every dollar of revenue than Google. The purpose of pointing out this large disparity is not that we need government policies to promote ISP interests over dot-com interests but that the nation needs to pursue industry-neutral policies and avoid promoting dot-com interests over the ISPs.

Effectively kill existing managed services

If eliminating future revenue and business opportunities weren't bad enough, Free Press wants to neuter ISPs' existing managed networks and services by disallowing "vertical prioritization" and dedicated bandwidth allocation. Free Press argues:

"Vertical Prioritization" — This model is one where an ISP simply prioritizes its own vertical content and services over all other content. This prioritization can be achieved either by flagging their traffic for priority, or by more subtle ways, such as de-prioritizing applications that are used to deliver classes of content that compete with the ISPs vertical content; or by the outright blocking of an IP application that competes with the ISPs own adjacent market services. Unlike the pay-for-play or pay-for-priority models, this business model involves no new income

streams, only the insulation of old streams from network-facilitated competition. But allowing ISPs to insulate their legacy vertical voice and video industries from the natural forces of competition is no recipe for investment — with reduced competition comes reduced investment incentives.

These proposed rules would effectively mean the end of managed services. Even the proposed draft of the FCC NPRM rules preserve vertical prioritization because these managed services, such as television and phone service, are a significant revenue source for ISPs that provides the critical funding for new network infrastructure. If the revenues of the three major U.S. ISPs were trimmed by 25 percent by severely curtailing their existing video and phone models and only existing ratios of revenue versus investment and jobs were considered, the three major ISPs would have to trim capex investment by \$9.7 billion and eliminate 156,000 jobs. That still would be equivalent to the total capex investment of all the dot-coms and more than the 108,000 jobs of the dot-coms combined!

We would recover some of the investment and jobs if the revenue were transferred to Google television (what YouTube will become) and phone (Google Voice) services, but it is an established fact that Google is more “efficient” when it comes to minimizing capex investment and employees while maximizing profit and stock valuations. The company is so efficient that if projecting from their current capex spending and employment habits, the transferred revenue would result in Google investing an additional \$2.3 billion and employing 37,000 more employees. That wouldn’t even begin to recover the net economic damage done to the ISP industry, and it would mean a net loss of 119,000 direct jobs and untold indirect job losses from the reduced capex investments. At a time that unemployment is at an all-time high and investment is already weak, the last thing the economy needs is the kind of job- and investment-killing regulations that Free Press is demanding.

Free Press wants FCC to mandate a dumb Internet

In addition to the economic damage, Free Press also wants the FCC to mandate a dumb Internet that is hostile to significant classes of Internet applications. To make their case, Free Press primarily relied on a previous Free Press paper from Chris Riley and Robb Topolski, “The Hidden Harms of Application Bias.”⁴ Digital Society thoroughly debunked⁵ it using hard data⁶. Furthermore, a prioritized network is actually more fair and neutral than the “dumb pipe,” “first in first out” (FIFO) network that Free Press worships.⁷

Why the Riley-Topolski paper is wrong

Riley and Topolski claimed that prioritized networks degrade low-priority applications, and therefore the technology is fundamentally bad. But prioritized networks (outside of managed services) only give priority to lower bandwidth applications that are sensitive to latency and jitter. No matter how much the network prioritizes voice-over-Internet protocol (VoIP) or online gaming, VoIP and gaming will never use more than a small fraction of the bandwidth used by peer-to-peer (P2P) file transfer. VoIP and gaming generally occupy less than 0.1 Mbps out of the average broadband connection of 4 Mbps downstream and 1 Mbps upstream in the United States, which means they get no more than 2.5

percent of the downstream network and 10 percent of the upstream network. If a P2P application is attempting to use more than 90 percent of the network and network prioritization limits P2P to 90 percent, this is a justifiable degradation, as the P2P application is still getting more than a fair share of the network.

Riley and Topolski claimed that prioritized networks degrade overall network performance. But this assertion is the opposite of reality and was proved wrong by test data.⁸ Furthermore, why would network operators implement a product that makes their networks less efficient? Cisco stated before the FCC QoS workshop that it can't sell a networking product that doesn't have prioritization technology because its customers value the enhanced efficiency of products with that capability.⁹

Riley and Topolski claimed that prioritization technology locks the Internet into typical usage patterns of 2009. QoS technology evolves with everything else, and it will remain accurate like it is today or else no one will use it. The risk of misclassification or application cheating is a non-issue because there is no benefit to cheating. Even if a high-bandwidth application manages to fool a router into giving it "priority," high priority merely grants low latency and not high bandwidth. Network devices like routers and switches can configure the high-priority, low-latency lane with a low-bandwidth ceiling so that priority cheating is counterproductive to high-bandwidth applications.

Lastly, Riley and Topolski argue that application bias has not been shown to be necessary or even substantially beneficial. This goes against the best knowledge of network engineering. Prioritized networks that protect latency-sensitive applications allow high-bandwidth applications to reach their full potential because they need not fear the repercussions. Without network protection for latency-sensitive applications like VoIP and online gaming, people who also use peer-to-peer (P2P) typically will shut down P2P while they use VoIP or online gaming. The more P2P users shut down, the fewer the number of computers that contribute to the seeder pool that is crucial to all P2P networks.

The fallacy of the dumb-network religion

The fundamental problem with Free Press' position is that it has put all of its misguided faith into the dumb network, which the group refers to as a FIFO network. The idea is that a FIFO network operates on a first-come, first-served basis and rules out any potential mischief on the part of the network operator. The belief is that the FIFO network operates in some kind of enlightened state without "application bias." Free Press claims that the Internet has always been a FIFO network (which is completely wrong because the Internet accommodated and even standardized out-of-order operation from the beginning) and should remain one.

The fallacy of this view is that Internet protocol networks are fundamentally biased, unfair and unbalanced toward certain classes of applications, such as VoIP, online gaming and video-conferencing. The main purpose of network prioritization is to undo this fundamental bias so that all applications get fair treatment from the network and that all applications work well.¹⁰

To illustrate how ridiculous a FIFO network is, we can look at what happens when a P2P application and VoIP application share a broadband connection. The FIFO network operates on a first-come, first-

served basis, which sounds fair but really isn't. That's because P2P applications can literally stuff hundreds of packets into the network operator's switch before a single VoIP packet makes it there. So by requiring FIFO operation, the network has to forward hundreds of P2P packets simply because they showed up first and before it forwards a single VoIP packet. The wait time forced on the VoIP packet is called jitter, and it causes the VoIP packet to expire, resulting in audio dropouts in the phone call.¹¹ This isn't even remotely fair, neutral or efficient, and it is simply a dumb way to run a network.

The fair way to operate the network is for the switch to sequentially forward hundreds of P2P packets or as many as necessary, so long as nothing else wants to use the network. If a few individual VoIP or gaming packets show up and the waiting line is filled with hundreds of P2P packets, the network will bump those VoIP and gaming packet to the front of the line and avoid delaying them with jitter. The result is that P2P will continue getting the lion's share of network bandwidth despite its low-priority status on the network switch, but it will not be allowed to induce packet expiration on VoIP, online gaming or other latency-sensitive applications.

Onerous regulations on existing wireless networks

Free Press would like to see a number of new regulations pushed onto the wireless broadband industry, and the groups wants the rules to be as onerous as their proposed regulations on the wired broadband industry. The problem is that the technical and economic differences in wireless broadband make Free Press' proposals doubly bad.

Free Press advocates the following wireless regulations

- Wireless networks should be treated the same as wired networks.
- High-bandwidth applications (e.g., P2P) should not be blocked on wireless networks.
- Carriers must allow attachment of any compatible device.
- Carriers can't be allowed to block tethering (attachment of PCs to phones).

Free Press apparently believes that wireless networks should be sold, operated and regulated the same as wired networks even though this has never been done before because the networks are simply too different in technical and economic terms.

Differences in capacity

- Wired networks use many wires, and each wire is a separate transmission medium, which multiplies capacity. For example, a DSL network has a separate wire going to each home, while a wireless, mobile cell with hundreds to thousands of users has only one transmission medium.
- The propagation characteristics are vastly different between wired and wireless networks. Signals in wires (especially cable networks) are relatively shielded from interference, and they don't disperse so the signal stays concentrated and strong. Mobile networks have wireless signals that disperse in many directions to achieve a wide coverage area, but the signal weakens rapidly with the square of the distance. Wires physically penetrate walls, which results in no signal loss upon entering buildings, but wireless signals are typically weakened 10-

fold when going through the walls of a house or building. The result is far less capacity (bits per second) for each hertz (Hz) when comparing wireless networks with wired networks.

- On cable broadband networks where even the last mile of wire is shared, the number of customers sharing the same wire (typically ~150) is significantly less than wireless networks that need to cover a few square miles or more. Furthermore, the differences in the transmission medium means that on average, we can get a lot more bits per hertz over a shielded coax cable than any wireless medium. The total available spectrum on a coax cable is also a few times higher than all the deployed commercial mobile radio services (CMRS).
- A single strand of single-mode fiber has many terahertz of spectrum capacity. The entire usable wireless spectrum for mobile or non-line-of-sight fixed wireless applications in a given area amounts to 2-5 GHz of capacity. Furthermore, CMRS spectrum is extremely expensive and scarce, and it is limited to a few hundred megahertz of capacity. Wireless networks have several thousand times lower spectrum capacity than fiber-optic wired networks.
- Mobile customers can physically move to different places, making it extremely difficult to support peak capacity requirements when many customers converge at a single location, such as a major convention. Wired customers stay in one place, making it much easier to allocate capacity.

High-bandwidth/duration applications severely degrade wireless networks

Free Press believes that wireless networks should be required to carry P2P traffic, but striking down existing terms-of-service restrictions (ToS) on wireless networks against heavy-bandwidth and heavy-duty cycle applications is not technically practical. Even the requirement to permit seemingly low-bandwidth VoIP applications on wireless networks is impractical for less obvious reasons.

- An HSPA 3G cell might have 7 megabits per second (Mbps) of total capacity shared between hundreds of users. For low-duration bursty bandwidth applications like Web surfing (which is what the vast majority of wireless customers want), it can multiplex (share) well. This is because each person is only using the bandwidth a small percentage of the time and for a few seconds, when they are actually loading the Web page, but remaining idle most other times.
- P2P and video streaming not only require high-bandwidth throughput, they sustain usage over several minutes or hours, which does not multiplex at all. This means that few P2P users can quickly take over large portions of the spectrum by opening hundreds of simultaneous connections.
- P2P causes severe jitter problems (on the order of hundreds to thousands of milliseconds) on 802.11¹² networks, which may have to be shared by hundreds of users. That means a single P2P user can ruin the gaming and VoIP experience of hundreds of Wi-Fi or white-space broadband users sharing the same base station.
- Wireless technology is typically not only constrained in Mbps, but there is also a packet-per-second limit (PPS) that can be overwhelmed with just a few P2P connections. Many wireless operators ban P2P for these reasons because they may not have a technical means of limiting PPS per user. Some Wireless Internet operators have used

- Less managed networks like Wi-Fi (802.11 technology) -- which soon will include white-space broadband networks (also 802.11 technology) – can't scale beyond a few concurrent VoIP users well because of the random packet collision/loss problem. An 802.11b network, for example, has 6 Mbps of usable bandwidth which theoretically supports 68 simultaneous uncompressed VoIP calls (G.711 codec) if bandwidth requirements are computed, but it only supports four of these VoIP calls in practice. A 5th (or more) VoIP call will result in so many random packet collisions and packet drops that all of the VoIP calls will suffer.

Differences in wired and wireless network economics

Free Press believes that wireless networks should be sold like wired networks with the same ToS, but this, too, is divorced from reality. It is about as realistic as demanding that mobile broadband cost the same, perform the same and have the same usage caps as wired broadband. No one expects to be able to use their wired broadband service on the road, and it's just as ridiculous to expect wireless networks to behave like wired broadband service. Here is why:

- Spectrum is expensive and sold for specific purposes.
- Most existing spectrum was auctioned without "open" Net Neutrality requirements, and most of the recent 700-MHz auction was sold at three times the cost of spectrum without open-access requirements.
- Wireless networks are far more competitive than wired networks and more competitive than mobile networks in other nations.¹³
- Smaller wireless ISPs have extremely heavy Internet transit costs, and they would be put under enormous strain if they were required to carry P2P traffic at equal priority.

Figure 1 – Wide range of mobile Internet business models

À la carte wireless Internet means lower prices



BlackBerry bold
\$100/month – AT&T
Cell, Web and email access
Can attach Computer

Apple iPhone
\$70/month – AT&T
Cell, Web and email access
No attaching of Computer

Peek simply email
\$20/month
Internet email only

Amazon Kindle
\$0/month
(paid via eBook revenue)
Only eBooks and websites
approved by Amazon

Free Press wants to ban single-device service plans, and that would force single-device users to subsidize multi-device users. But unlike wired broadband services, wireless services are sold in single-

device (non-sharable) or multi-device (sharable) plans. Single-device plans typically cost \$30 per month, while multi-device plans cost \$60 per month. Multi-device plans allow customers to share their Internet access with nearby friends, family, co-workers or anyone they like, so they naturally cost more. Free Press claims to be protecting users, but its proposal would raise the price of mobile broadband for the majority of people by requiring them to buy features they don't need.

Free Press wants consumers to be able to attach any compatible device, but they already can if they pay for general-purpose connectivity. Devices like the Novatel MiFi with Verizon's mobile wireless network allow customers to connect any device they want using Wi-Fi, including AT&T exclusive GSM iPhones that are currently incompatible with Verizon's CDMA mobile network. But Free Press' proposal would shut down a wide range of successful special-purpose business models that have restrictions not seen on wired networks.

- Mobile Internet is sometimes paid for by the content/application provider rather than by the user. Amazon Kindle users, for example, don't pay for connectivity on the Kindle, but Amazon heavily restricts the Internet access.
- Mobile Internet is sometimes sold for application-specific devices such as the Peek Simply e-mail device. Peek customers don't specifically pay for mobile connectivity, but the Peek only permits its users access to a limited number of e-mail accounts, and all other Internet applications and protocols are blocked on the device.

Consumers should have the right to buy general-purpose mobile Internet access, but they also should have the right to buy less expensive services that are limited to the features they need. The wireless business models we have are examples of market success, and they are among the few bright spots of an ailing economy. Consumers should continue to have a choice between general-purpose and special-purpose products.

¹ Free Press, "Clear Net Neutrality Rules Will Promote Investment, Innovation and Competition," Jan 15, 2010, <http://www.freepress.net/node/76056>

² George Ou, "FCC NPRM ban on Paid Peering harms new innovators," Digital Society, November 10, 2009, <http://www.digitalsociety.org/2009/11/fcc-nprm-ban-on-paid-peering-harms-new-innovators/>

³ George Ou, "Preserving the open and competitive bandwidth market," Digital Society, January 14, 2010, <http://www.digitalsociety.org/2010/01/preserving-the-open-and-competitive-bandwidth-market/>

⁴ Chris Riley and Robb Topolski, "The Hidden Harms of Application Bias," Free Press, November 2009, http://www.freepress.net/files/The_Hidden_Harms_of_Application_Bias.pdf

⁵ George Ou, "Debunking the myth that prioritized networks are harmful," Digital Society, November 12, 2009, <http://www.digitalsociety.org/2009/11/debunking-the-myth-that-prioritized-networks-are-harmful/>

⁶ George Ou, "Test data disproves Free Press anti-prioritization paper," Digital Society, November 18, 2009, <http://www.digitalsociety.org/2009/11/test-data-disproves-free-press-anti-prioritization-paper/>

⁷ George Ou, "What is true neutrality in the network?" Digital Society, November 19, 2009, <http://www.digitalsociety.org/2009/11/what-is-true-neutrality-in-the-network/>

⁸ George Ou, "Test data disproves Free Press anti-prioritization paper," Digital Society, November 18, 2009, <http://www.digitalsociety.org/2009/11/test-data-disproves-free-press-anti-prioritization-paper/>

⁹ George Ou, "FCC Technical Advisory Process Workshop QoS discussion," Digital Society, December 11, 2009, <http://www.digitalsociety.org/2009/12/fcc-technical-advisory-process-workshop-qos-discussion/>

¹⁰ George Ou, "What is true neutrality in the network?" Digital Society, November 19, 2009, <http://www.digitalsociety.org/2009/11/what-is-true-neutrality-in-the-network/>

¹¹ George Ou, "The need for a smarter prioritized Internet," Digital Society, September 23, 2009, <http://www.digitalsociety.org/2009/09/the-need-for-a-smarter-prioritized-internet/>

¹² 802.11 is the IEEE technology standard used for "Wi-Fi" or "White Space" wireless networks.

¹³ Ehrlich, Eisenach, Leighton, "The Impact of Regulation on Innovation and Choice in Wireless Communications," SSRN, September 2009, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1478528